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## THE HANDLING OF CALIFORNIA TABLE GRAPES

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## INTRODUCTION

More than 90 per cent of the commercial grape crop of the country consists of vinifera or European grapes, and is produced in the warm interior valleys and mild coastal areas of California. The production of grapes in these regions dates back into the eighteenth century.

The Mission grapes, first planted at the Spanish missions at San Diego and San Gabriel, in 1769 and 1771, were apparently the most important cultivated fruit in California until after 1850.

According to Eisen,<sup>1</sup> in 1852 vines of the Alexandria Muscat and in 1861 cuttings of Gordo Blanco were imported from Malaga, Spain, by Agoston Haraszthy, who is reported to have brought more than 50 varieties of grapes from Europe. At about the same time other introductions were made, including the Flame Tokay in 1857;<sup>2</sup> which resulted in definite plantings of grapes especially adapted for raisin and table use. The earliest record of the production of cured raisins seems to have been in 1863 when John Strentzel, of Martinez, Calif., and others exhibited Muscat and dried grapes at the California State Fair.<sup>3</sup>

## PRODUCTION OF VINIFERA GRAPES

The extent of the table-grape industry in California prior to 1912 is indicated by the number of carloads of fresh grapes that were marketed, as shown in Table 1.

<sup>1</sup> EISEN, G. THE RAISIN INDUSTRY. A PRACTICAL TREATISE ON THE RAISIN GRAPES, THEIR HISTORY, CULTURE, AND CURING. 223 p., illus. San Francisco. 1890.

<sup>2</sup> LANDSBOROUGH, L. M. THE FLAME TOKAY. Calif. Grape Grower 6 (9) : 8, illus. 1925.

<sup>3</sup> CALIFORNIA STATE AGRICULTURAL SOCIETY. FARM PRODUCTS ENTRY. Calif. State Agr. Soc. Trans. 1863 : 79-80, 83. 1864.

TABLE 1.—*Shipments of fresh grapes from California for the years 1902 to 1912*[Compiled from the annual numbers of the California Fruit Grower]<sup>1</sup>

Crop year	Carloads	Crop year	Carloads	Crop year	Carloads
1902.....	1,033	1906.....	2,052	1910.....	4,948
1903.....	1,804	1907.....	3,460	1911.....	6,375
1904.....	1,451	1908.....	3,816	1912.....	6,354½
1905.....	1,602	1909.....	5,875		

<sup>1</sup> STUBENRAUCH, A. V., and MANN, C. W. FACTORS GOVERNING THE SUCCESSFUL STORAGE OF CALIFORNIA TABLE GRAPES. U. S. Dept. Agr. Bul. 35, 31 p., illus. 1913.

The area planted to table grapes in California, as estimated by the California crop-reporting service in 1926, was approximately 151,000 acres, of which 7,000 acres were listed as young or nonbearing vineyards. The plantings of wine grapes, 174,000 acres, slightly exceed those of table grapes; whereas the raisin-grape plantings, 355,000 acres, are considerably greater than those of table and wine grapes combined. Considerable portions of the younger vineyards of table and wine grapes have not yet reached full bearing. Increased production of these vineyards, however, is likely to be offset, to some extent at least, by declining yields or abandonment of some vineyards.

The commercial production of table grapes is indicated in Table 2, showing the carload shipments from California for the years 1925 to 1928.

TABLE 2.—*Shipments of table grapes from California for the years 1925 to 1928*<sup>1</sup>

Variety	Shipments for the years 1925 to 1928, inclusive, to dates given (carloads)			
	Nov. 13, 1925	Nov. 2, 1926	Nov. 7, 1927	Nov. 10, 1928
Alexandria (Muscat of Alexandria).....			205	166
Black Prince.....			36	20
Cornichon.....			587	577
Emperor.....	3,652	2,187	1,996	3,224
Malaga.....	4,259	3,361	6,608	6,659
Castiza (Maravilla de Malaga).....			118	133
Ohanez (Almeria).....			34	195
Rose of Peru.....			12	8
Sultanina (Thompson Seedless).....	2,757	2,814	4,496	4,027
Flame Tokay.....	3,929	3,181	6,739	7,414
All others.....	947	814	485	582
Total.....	15,544	12,357	21,316	23,005

<sup>1</sup> Figures for 1927 and 1928 are based on statistics compiled by the California Vineyardists Association. Figures for 1925 and 1926 are estimates based on the number of carloads of the different varieties that were inspected by the Federal-State inspection service.

Table and raisin grapes in California are grown mainly in the warmer parts of the San Joaquin and Sacramento Valleys and in the southern part of the State. Because of the considerable variation in the time of ripening of table grapes in different localities and for commercial purposes it is customary to consider the vineyard area of the State as divided into four principal districts.

The earliest shipping district is in the Imperial and Coachella Valleys, in the extreme southeastern portion of the State, in which

annual table-grape shipments amount to less than 1,000 carloads and are principally of the Sultanina (*Thompson Seedless*) and the Malaga varieties. The Sultanina ripens slightly earlier than the Malaga and is harvested as early as June 20 in normal years. Table grapes are not extensively grown elsewhere in this district, although there is a considerable acreage of juice grapes east of Ontario and in many smaller plantings. The central district includes the large acreage planted to table grapes in the San Joaquin Valley. It is the most important source of table grapes, furnishing the major shipments of Malaga, Sultanina, and Emperor varieties. The northern district includes the Sacramento Valley. The principal table grape in this area is the Flame Tokay, which is most largely grown in the Lodi, Florin, and American River sections. A number of other varieties of table grapes are important in this district. The coastal district is principally devoted to the growing of juice grapes in Napa, Sonoma, Contra Costa, and Santa Clara Counties, and table grapes are relatively unimportant.

#### PRINCIPAL VARIETIES OF TABLE GRAPES

The table-grape industry in California is based mainly on the production of three leading varieties, the Malaga, the Flame Tokay, and the Emperor, which comprise 90 per cent of the total plantings of table grapes. Large shipments of the important raisin variety, the Sultanina, are also marketed as table grapes. Ohanez (shipped as Almeria), Olivette Noir (*Cornichon*), Rose of Peru, Castiza (*Maraville de Malaga*), Hunisa, and Olivette Blanche are among other varieties of commercial importance; and several more recent introductions—Monukka (*Black Monukka*), Gros Guillaume, Khandihar, and Prune de Cazouls—give some promise.

The earliest table-grape shipments from the State are of Sultanina, Malaga, and some Persian varieties, including Khalili and Khandihar, which ripen in July and August. Flame Tokay shipments usually begin in August and continue through September and October. The Emperor is shipped with the late Malaga and Flame Tokay grapes from about the first of October, and shipment continues until the crop is severely damaged by rain or frost.

#### FACTORS TO BE CONSIDERED IN HANDLING AND PACKING

The shipping and storage qualities of vinifera grapes are largely influenced by certain characteristics of the bunches and berries, such as the firm pulp strongly adhering to the skin, the attachment of the berries to the pedicels, and the seedlessness of the Sultanina and Monukka. Varieties that are classed as good shippers (Emperor, Ohanez, Cornichon, and Flame Tokay) are generally more resistant to injuries in handling, such as bruising, splitting, or loosening of the berries at the pedicels or cap stems, and to attacks by organisms which cause decay than are the fair shippers (Malaga, Rose of Peru, Black Prince, and Castiza) and much more resistant than the poorer shippers (Alexandria, Olivette Blanche, and Sultanina).

The bunches are either compact, well filled, loose, or straggly. In most varieties they tend to conform to one or the other of these types, although there is considerable variation on the same vine.



In compact clusters the berries are held more or less rigidly and hence are easily bruised or split by abrasion or by the weight of the fruit in the picking boxes or in the containers in which the grapes are packed. Compact bunches require careful work in culling to remove soft, split, or defective berries; also care in packing.

The thickness, strength, and flexibility of the pedicels and the adherence of the berries to them largely determine the susceptibility of grapes to various injuries during ordinary handling. In such varieties as the Emperor and Ohanez the pedicels are comparatively thick and stout and the berries are firmly attached to them. Thin or fragile pedicels in varieties like the Sultanina are easily affected by wilting or drying.

When grapes are held too long in the warm, dry atmosphere of a packing house the stems become dry and brittle and the berries shatter easily. In Sultanina and Olivette Blanche the condition may become so extreme that it reduces the selling price of the grapes on the market. It can be largely prevented by careful handling and packing and by prompt loading of the grapes into an iced refrigerator car.

The splitting or loosening of the berries at the point of attachment of berry and cap stem is one of the commonest injuries in handling. It occurs to some extent even in the Malaga, in which the cap stems are rather thick and flexible, but is so common in the Alexandria, probably because of the less flexible cap stems, that it is almost always a factor in determining the carrying quality of that variety. The careful handling of grapes that are especially subject to this injury is difficult but nevertheless important if the best possible carrying quality is to be maintained.

Apart from the normal variations in different varieties of grapes, the occurrence of defective or poorly formed berries and various blemishes sometimes affects the shipping quality of the fruit. The cause of certain abnormal or diseased conditions found on stems and berries is not well understood in some cases, nor are satisfactory methods of control known. Almeria spot of the Ohanez and other grapes sometimes affects the appearance and sale of the fruit, but it has not been shown to injure the keeping quality during the usual period of cold storage. This spotting of the berries consists of small brownish or darkened portions of the flesh which develop between the seed and the skin of the berry. Grapes that have developed the abnormal condition known as "water berry" or "red berry" have thin skins and are easily split or cracked. They are usually removed in culling. The stems of certain bunches may show a weak, flabby, or immature condition and fail to cure normally. Parts of the stem may become moldy or entirely wilted and black. The bunches showing this condition are usually unsatisfactory for shipment, chiefly because of the appearance of mold on the stems. Powdery mildew causes wilting, discoloration, or scarring of the stems and berries and becomes important in affecting the shipping qualities of table grapes, mainly during or following a period of moist or wet weather. It can usually be controlled by proper treatment in the vineyard.

Losses of fruit in the vineyard and injuries to the keeping quality of the portion that is harvested are caused by heavy rains, hail, extreme heat or sunburning, frost, and damage by pests. The actual loss of fruit from these causes is usually slight, with the exception of rain damage, which is an important factor in the marketing of late-ripening grapes. Heat injury sometimes causes fine cracks in the skin of the berries, which may become infected with decay fungi.<sup>4</sup> Sunburn in severe cases produces a charring or spotting of certain berries or entire bunches in the varieties that are most susceptible to injury from heat. The Alexandria and the Flame Tokay are more or less subject to such injury in the central district, while the Malaga under similar conditions of temperature or hot winds may not be affected.

#### WILTING AND SHRIVELING

Many varieties of table grapes tend to wilt or lose moisture rapidly after they are picked if held in a dry atmosphere and at high temperatures. It is important, therefore, on warm dry days to avoid delays in packing and handling and to load the grapes into an iced refrigerator car as soon as possible after they are picked.

Certain varieties, particularly if they are mature or overmature when picked, may have one or several partly dried, discolored berries on the bunches. In some cases the affected berries show merely a soft, shriveled condition with the skin finely wrinkled. These are usually clipped out when the grapes are packed; if not removed they may continue to shrivel after the grapes are packed and shipped or held in storage, especially in the Alexandria, Sultanina, and Malaga varieties. The affected berries do not usually form true raisins, but become fermented or bitter to the taste. When the grapes are taken from the car to a higher temperature they are likely to mold.

In storage experiments these wilted berries did not develop into true raisins during a storage period of 60 to 90 days or longer; in some cases they increased in number during the period held, particularly in the riper lots of grapes. They were attacked by gray mold or blue mold soon after being removed from the 32° F. storage temperature.

Although certain factors in the handling of grapes in which true raisining is troublesome need further investigation, the losses from the shriveling heretofore described may be kept at a minimum by picking the grapes while they are still in good shipping condition and by prompt handling and refrigeration.

#### RAIN DAMAGE

The keeping quality of late-harvested grapes is usually affected to a considerable degree by heavy or long-continued rains occurring late in the season. It may not be seriously affected if the rain is light and is followed by clear and dry or cool weather. If the grapes remain wet on the inside of the bunches there is usually rather severe

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<sup>4</sup> Injuries resulting from heat, hail, rain, and other means were found to be infected with decay-producing organisms, as reported in unpublished studies of the fungous organisms attacking grapes in the vineyard and after harvesting, by Dean H. Rose and W. S. Ballard, of the Bureau of Plant Industry, in 1926.

injury and the beginning of decay. Rain causes the berries to loosen at the cap stems and often produces small semicircular cracks in the skin near the ends or on the sides of the berries. All of these are ideal starting places for decay from gray mold or black mold. Grapes that have been injured by rain are usually too uncertain in their keeping qualities to be satisfactory for the sawdust pack or for storage.

The effect of these injuries on the keeping quality has been shown in storage experiments with Emperor grapes. In one of these experiments, grapes that were picked two days before a heavy rain were packed in sawdust and stored at a temperature of 32° F. Comparable lots of grapes showing injury from rain were picked in the same vineyard eight days after the rain, which wet them thoroughly, and were held under similar storage conditions.

In a second experiment, Emperor grapes that had been picked and stored seven days before the rain were compared with grapes picked four days after the rain. In both experiments the methods of handling were similar except that the rain-damaged bunches required more culling in order to remove split, cracked, and loose berries.

TABLE 3.—*Rain damage to Emperor grapes*

Lot number and condition of fruit	Weight of grapes in each lot	Time in storage at 32° F.	Decayed and shattered berries	
			When grapes were removed from storage	After grapes were held for 7 days at 65° F.
	<i>Pounds</i>	<i>Days</i>	<i>Per cent</i>	<i>Per cent</i>
Lot 1, grapes picked before rain.....	121	46	0.3	1.2
Lot 2, grapes showing rain damage.....	132	36	4.1	23.7
Lot 3, grapes picked before rain.....	166	83	1.3	3.4
Lot 4, grapes showing rain damage.....	152	72	16.0	61.0

The grapes in lot 1, which were picked before the rain, were in sound condition after 46 days in storage. The corresponding lots, picked after the rain, developed 4.1 per cent of decayed, moldy, and shattered berries in 36 days of storage. After removal from storage, part of each lot was held for 7 days at a temperature of about 65°F., to represent a market-holding condition. The development of decay was greatly increased at this higher temperature. There was comparatively rapid breakdown of the lots picked after the rain, the final inspection of these lots showing 23.7 per cent of decay and shattered berries in this fruit after it had been held for 7 days at the higher temperature.

In lots 2 and 4 the rain-damaged grapes showed a greatly increased susceptibility to decay and deterioration. The uninjured grapes were in practically sound condition after 83 days in storage and 7 days at the higher temperature. The grapes from the same vineyard picked after the rain and showing rain injury contained many berries with small but rather deep cracks in the skin and many berries that were slightly loose at the cap stems. Those most severely injured were removed before packing. This lot (lot 4) developed



very high decay during the storage period. In all cases the percentage of decay increased at a much faster rate after the grapes were removed from cold storage.

#### MATURITY

The changes in the grape that are associated with ripening or attaining satisfactory maturity for dessert purposes are the development of the characteristic color and certain qualities of texture and flavor that are recognized as characteristic for the variety. These changes reach a stage in which the grape has attained nearly its maximum acidity and sugar content, after which there is a gradual decrease in acidity and an increase in the sugar or soluble solids, which is the most important index of the palatability and wholesomeness of the fruit.

Grapes develop their highest characteristics of color, flavor, and palatability on the plant or vine; they do not ripen or increase in sugar content after they are picked, although the juice may become slightly more concentrated by the loss of water from the berries. The picking maturity of the grape, therefore, should represent the condition of each variety when it has attained satisfactory maturity for immediate use.

As grapes approach maturity the stems usually change from a leaf-green to a light-green or straw color, and in many varieties a woody portion resembling the cane and known as the "woody seal" forms at the base of the stem. This condition is usually associated with advanced maturity and best keeping quality. In this condition the stems are relatively tough and less easily broken in the picking and handling of the grapes. In the Sultanina and Olivette Blanche the stem is more delicate and brittle than in the Malaga and Emperor and requires more careful handling if damage is to be avoided.

In the storage experiments with Emperor and Malaga grapes, dark-green stems were frequently attacked by molds or became discolored in storage. Stems having a leaf-green color may wilt and turn black, which mars the appearance of the grapes. Stems that have developed a straw color usually cure in storage, change to a brown or light-brown color, and finally become dry, but not especially brittle. In experiments in the storage of Emperor grapes, mature stems, when not associated with overripeness of the fruit, have been shown to indicate comparatively good keeping quality and to be rather resistant to attack by mold.

In order to obtain grapes of uniform maturity, it is usually necessary for the pickers to go over the vineyard two or three times, picking only the bunches that have developed satisfactory color and condition of berries and stems.

Although the development of sugar largely determines when the variety has attained its prime condition or highest dessert quality, the maximum sugar content is not always an indication of the most satisfactory palatability. Furthermore, the impression that an extremely high sugar content is a protection against decay or that it indicates good keeping quality of the grape is disproved by the comparatively early decline and decay of grapes that may be classed as overripe when placed in storage.

## HARVESTING OR PICKING

The care with which grapes are handled by the pickers is one of the most important factors affecting the keeping qualities of the fruit in transit and after arrival on the market. As a rule, the least-skillful labor is employed, and often there is comparatively little effective supervision of its work.

Because of the relatively short harvesting season and the great demand for labor, the picking and handling of grapes is often done largely by itinerant laborers, except the packing, which is usually done by women living in the various districts. (Fig. 1.) For this reason it is often difficult to obtain as careful handling of the fruit as is desirable.

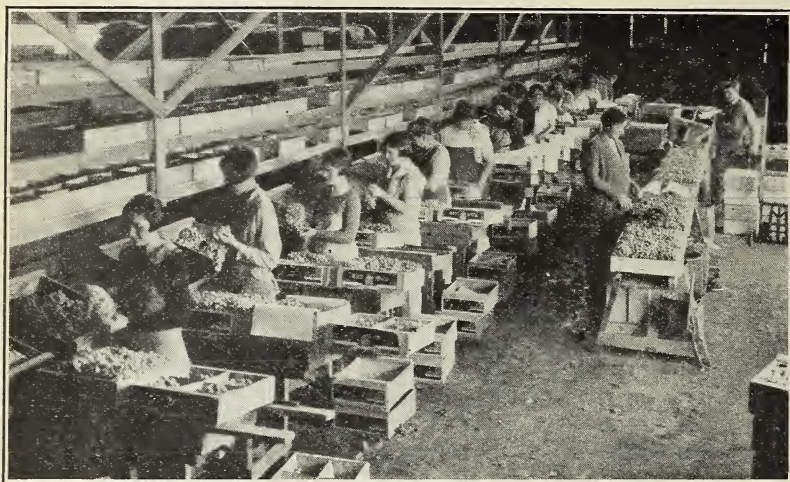


FIGURE 1.—Packing table grapes in lug boxes and 4-basket crates. Each bunch of grapes is examined by the packer, and defective berries are removed. The grapes are placed in boxes or crates containing fruit of similar grade. The grading and packing operations receive careful supervision

The most common form of injury in the picking of grapes is the splitting and loosening of the berries at the pedicels, because of the bending, twisting, or severe squeezing of the bunches. The picker sometimes grasps the side of the bunch as he clips the stem, or forms a cup with one hand into which the bunch drops when the stem is cut. The twisting and bruising of the grape berries resulting from the use of these methods may be avoided if the pickers follow the rule of always holding the bunches by the stem in taking them from the vine and in placing them in the field boxes. (Fig. 2.) Bunches that have grown around a cane or a leafstalk are often much bruised and torn in pulling them loose, although they can usually be handled by a careful picker without such injury. The bunches should be placed carefully in the picking boxes one layer deep, with the stems up. It is possible to get the desired quantity of fruit one layer deep in each picking box if the boxes are tilted by propping one end against another box so that the first row of bunches rests against the end of the box. Grape leaves placed in the bottom of the picking



boxes form a cushion for the grapes and tend to prevent abrasion, although their presence there is undesirable if it results in the carrying of any disease of the vine. The boxes when filled should be

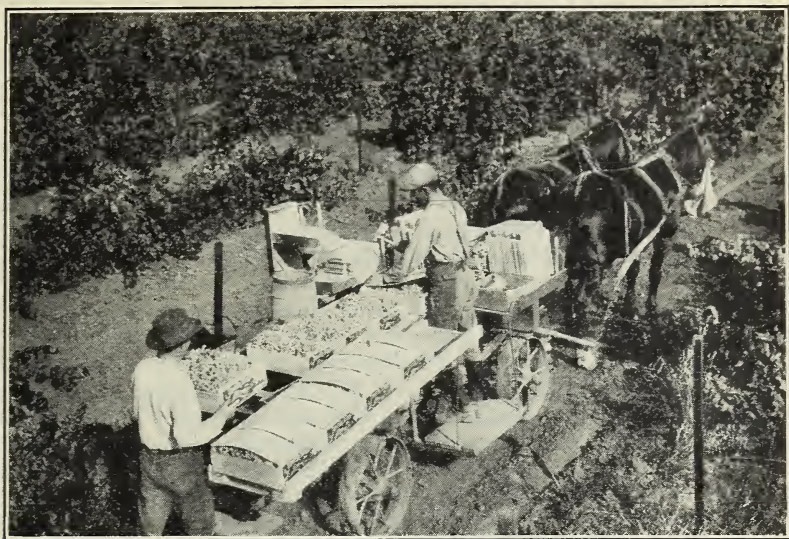


FIGURE 2.—Field-pack grapes are picked, graded, and packed by the same workmen



FIGURE 3.—Light wagons are sometimes used in the vineyard for assembling field-pack grapes. The packed fruit is hauled by motor truck to a packing house or a loading station, where it is loaded into refrigerator cars for shipment

covered or placed in the shade. Figure 3 illustrates one of the methods used in handling field-pack grapes.

Considerable injury to the fruit may result from rough handling in the loading of trucks or wagons in the vineyards or in unloading

at the packing house when the grape boxes are dropped one on the other. Picking boxes that are filled too full often show many crushed or bruised berries in the bunches that project above the sides or ends of the boxes. This rarely occurs, however, if the bunches are placed in the boxes only one layer deep.

#### METHODS OF HANDLING AND PACKING

The causes of decay and deterioration of table grapes in transit and on the market have been the subject of investigations conducted by the Bureau of Plant Industry at two or three separate periods. Some of these investigations have been concerned with the effects of the methods used in the picking and packing of table grapes and of refrigeration upon the keeping quality of the fruit.

A careful inspection of many lots of grapes in the picking boxes and after the fruit was packed frequently showed a rather high percentage of small injuries and in some cases severe ones, such as split, loosened, or bruised berries. In determining the effects of such injuries upon the carrying quality of the fruit, shipping and storage tests were made with carefully handled and ordinary commercially handled grapes picked from the same vineyards. The commercially handled fruit in the experiments represents the results produced by a type of handling that may be somewhat below the average for the industry as a whole, but was typical of methods actually in use at the time. The carefully handled grapes were picked and packed by the man engaged in the bureau investigations or by careful workers employed for this purpose. The commercially handled fruit was picked and packed by the regular crews. The comparable lots of fruit were handled at approximately the same time and were either packed and held in storage in an iced refrigerator car or shipped in refrigerator cars at similar temperatures. Care was taken that the grapes used in these experiments in both the carefully handled and the commercially handled packs should be of uniform quality and maturity. A large number of separate lots of grapes from various growers were used in order to cover a wide range in the fruit and in the character of the handling methods represented.

Part of the grapes used in these experiments were held in storage in an iced refrigerator car on the siding at one of the grape-packing houses. The temperature inside this car was approximately the same as that of an iced refrigerator car in transit. In the shipping experiments the grapes were forwarded to New York in regular commercial shipments made in iced refrigerator cars. Both lots of grapes, representing careful and ordinary commercial handling, were inspected on arrival in the market in the case of the shipping experiments, and in the storage experiments at the end of 12 days in the storage car. After the grapes were taken out of the car they were held for six or seven days in a produce-storage room kept at a temperature of 68° to 70° F. The comparative condition of the grapes in all shipments and storage lots was determined by removing from the bunches and weighing the berries that showed evidence of decay or mold from gray mold or other organisms or of physiological deterioration, and all shattered, split, or broken berries. The total percentage of the grapes that were not in mer-



chantable condition as a result of mold, decay, or some form of deterioration was classed as "total deterioration." The results of the grape-shipping and storage experiments are given in Figures 4 and 5.

Figure 4 shows the percentage of total deterioration in experimental shipments of carefully handled and commercially handled

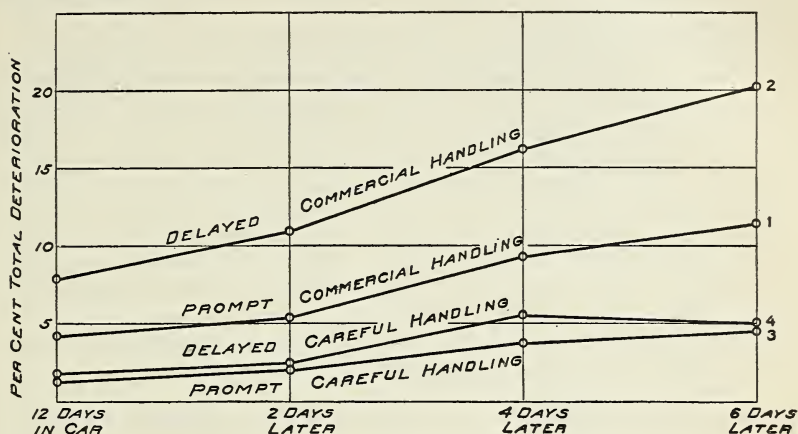


FIGURE 4.—Comparison of careful and ordinary handling, as shown by the effect on the keeping qualities of Malaga grapes after 12 days in transit in an iced refrigerator car and 2, 4, and 6 days under market conditions. Deterioration includes decayed, moldy, shattered, injured, and raisining berries

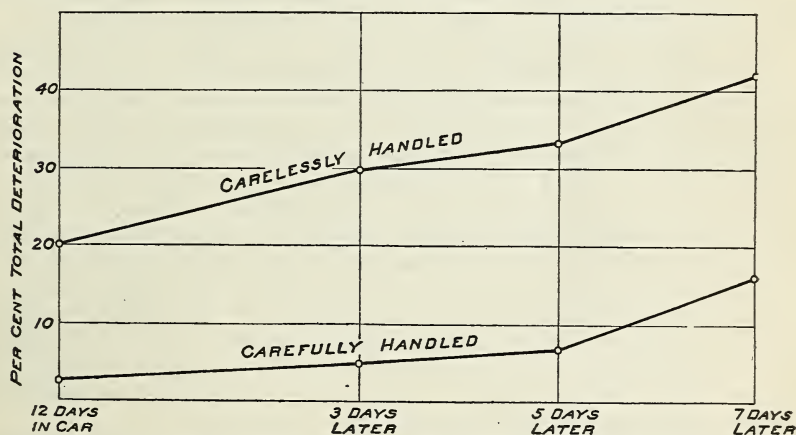


FIGURE 5.—Comparison of careful and careless commercial handling, as shown by the effect on the keeping qualities of Flame Tokay grapes after 12 days in transit in an iced refrigerator car and 3, 5, and 7 days under market conditions. Deterioration includes decayed, moldy, shattered, injured, and raisining berries

Malaga grapes on arrival in New York and after holding in the market for 2, 4, and 6 days. This chart gives the results of seven shipping tests consisting of eight boxes of grapes in each lot of carefully handled and commercially handled grapes. The effect of delayed handling and shipping, compared with immediate or prompt handling and shipping on the day the grapes were picked, is indicated by the two curves showing "delayed handling."

The carefully handled grapes showed an average loss from decay and deterioration that was less than one-third as great as that which occurred in the grapes handled by the regular pickers and packers. The difference in the condition of the fruit is also indicated in the comparison of the carefully handled and commercially handled lots when inspected after holding for 2, 4, and 6 days in the market, the carefully handled fruit showing very much less rapid deterioration during the entire period.

The effect of a delay of 24 to 48 hours in the handling and refrigeration of Malaga grapes is shown in lines 2 and 4 of Figure 4. A comparison of lines 1 and 2 and of 3 and 4 shows that the delayed handling of these grapes was an important factor in the increased decay and deterioration found in this fruit on arrival in the market and later. The effect of delayed shipment proved to be directly proportional to the care with which the grapes had been handled and the extent to which they were free from injuries such as loosened cap stems and split or bruised berries. The comparatively rapid rate of increase in the decay and deterioration of the commercially handled lots after a delay of 24 to 48 hours in the shipment or refrigeration of the fruit showed the very great importance of careful handling and prompt refrigeration of table grapes.

#### COMPARISON OF RESULTS OF CAREFUL AND CARELESS HANDLING

The work of different individuals may show considerable variation in respect to the care they use in the handling of the grapes and the resulting presence or absence of various injuries that render the fruit more susceptible to decay and physiological breakdown.

Five series of experiments were made with Flame Tokay grapes handled by careful workers and by careless workers. In each series eight crates of grapes from each set of workers were held in the iced refrigerator car at approximately the temperature of fruit under refrigeration in transit. The grapes used in the tests were obtained on different days and from five different groups of workers. Selections of fruit for the experiments were made after an examination of the work of the various persons in the picking crews had shown certain ones to be careful in their methods and others rough and careless.

Figure 5 graphically shows a comparison of the percentage of total decay and deterioration in the fruit handled by the careful workers and that handled by the careless workers after 12 days in storage in the iced refrigerator car and after the fruit had been held in a produce room for 3, 5, and 7 days. Care was taken to hold the various lots under similar temperature conditions.

The results of the inspections showed a very marked difference in the condition of the grapes. Those handled by the careless workers showed from three to seven times as much deterioration as those handled by the careful workers, after being held 12 days in the car and 7 days under approximately market conditions. The grapes handled by the careful workers did not deteriorate rapidly until at least 5 days after removal from the car. Those handled by the careless workers did not remain in sound condition even during the 12 days in storage in the car, and they deteriorated somewhat more rapidly after being transferred to a higher temperature. The grapes

picked and packed by the careful workers were still in merchantable condition 7 days after they were unloaded from the storage car. After holding for 7 days under approximately market conditions the grapes that had been picked and packed by the careful workers showed less decay and deterioration than had developed in those handled by the careless workers even before the latter were removed from the car.

The results of the experiments indicate the very great importance of maintaining a uniformly high standard of careful handling in the picking, packing, and shipping of table grapes.

# ORGANIZATION OF THE UNITED STATES DEPARTMENT OF AGRICULTURE

November 15, 1929

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